Please paste the barcoded label here	TOTAL MARKS

INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION
NOVEMBER 2022

COMPUTER SCIENCE: PAPER II

EXAMINATION NUMBER													

Time: 3 hours 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 30 pages. Please check that your question paper is complete.
2. Read the questions carefully and make sure that you answer all parts of all the questions.
3. **Answer ALL the questions on the question paper and hand it in at the end of the examination. Remember to write your examination number in the space provided above.**
4. Show all working where applicable.
5. A non-programmable calculator may be used.
6. It is in your own interest to write legibly and to present your work neatly.
7. TWO blank pages (page 29 and 30) are included at the end of the paper. If you run out of space for a question, use these pages. Clearly indicate the number of your answer should you use this extra space.

FOR MARKER'S USE ONLY

Question	1	2	3	4	5	6	7	8	**Total**
Marks	**7**	**25**	**28**	**14**	**22**	**10**	**19**	**25**	**150**
Marked									
Moderated									

SECTION A SHORT QUESTIONS

QUESTION 1 DEFINITIONS

Give the most appropriate term for each of the following descriptions:

1.1 A specification used to install high speed storage devices using little power in small spaces.

_____

(1)

1.2 A signal from a device requiring attention from the CPU.

_____

(1)

1.3 The technique which uses secondary storage when the loaded applications require more RAM than is available.

_____

(1)

1.4 The four steps (fetch, decode, execute and store) taken by the CPU to process an instruction.

_____

(1)

1.5 The time that it takes for a device or component to respond.

_____

(1)

1.6 A protocol that resolves an IP address to a MAC address.

_____

(1)

1.7 A text file that stores a user's preferences when browsing the Internet.

_____

(1)

7 marks

SECTION B SYSTEM TECHNOLOGIES

QUESTION 2

SCENARIO

Consider the following scenario when answering the rest of the examination paper, unless otherwise stated or the questions are of a general nature.

> The Smith family have bought a campervan and intend to travel for six months across Southern Africa. The Smith family consists of four people including two teenage girls, Ariel and Anastasia.

Both the girls, Ariel and Anastasia, have gaming laptops with the following specifications:

Processor	Intel i7 up to 4.5 GHz 6 × Cores; 12 × Threads 384 KB level 1 Cache 1.5 MB level 2 Cache
RAM	16 GB DDR4 RAM
Storage	512 MB Solid State Drive 1 TB Hard Disk Drive
Graphics	NVIDIA GeForce 4 GB GDDR5 RAM
Connectivity	Wi-Fi enabled LAN port Bluetooth enabled
Operating System	Windows 10

2.1 The processor is an Intel i7 with 384 KB level 1 cache and 1.5 MB level 2 cache.

2.1.1 Name THREE parts of a processor.

Part 1: _____

Part 2: _____

Part 3: _____

(3)

2.1.2 What is the purpose of processor cache?

_____

_____

_____

_____

(2)

2.2 The processor has 6 cores and 12 threads.

2.2.1 Name the hardware technique which allows for the processing of double the number of threads than there are cores in the processor.

_____

(1)

2.2.2 Explain how this hardware technique increases processing efficiency.

_____

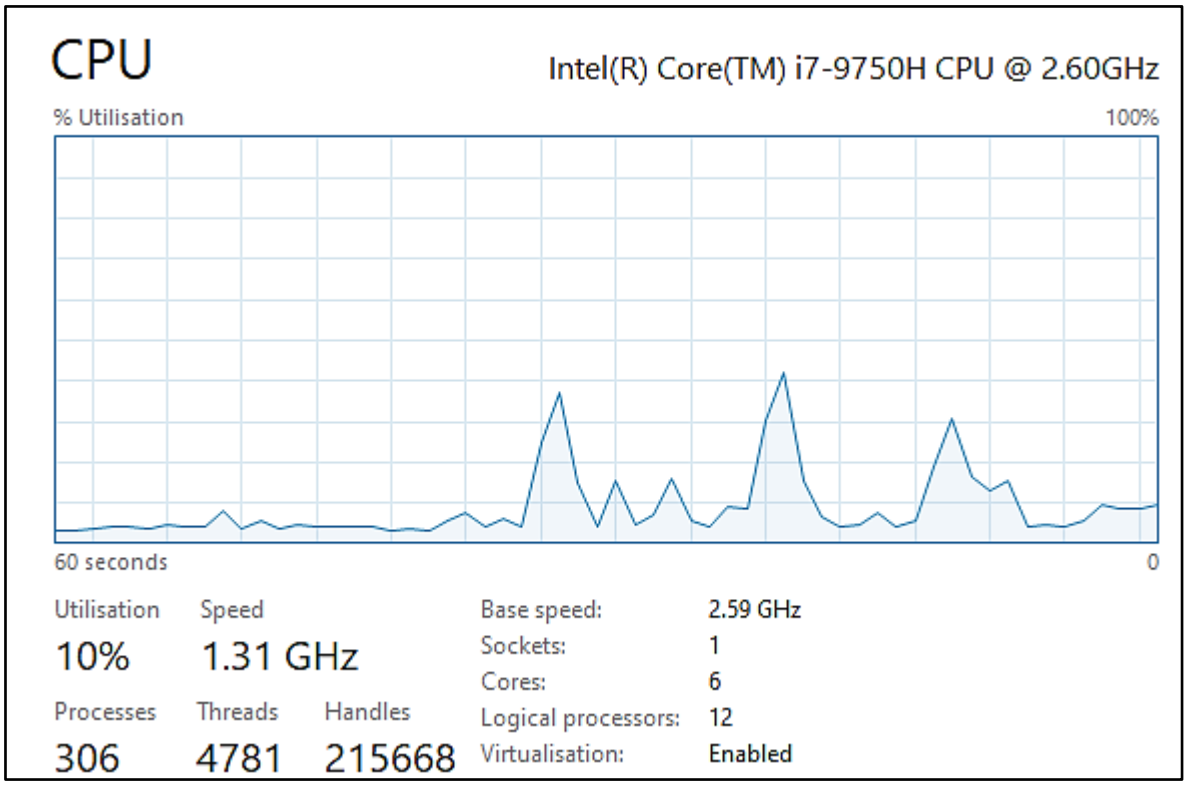
_____

_____

_____

(2)

2.3 Ariel is looking at her CPU utilisation in her Task Manager.



2.3.1 Name the software technique that enables her CPU to have 306 processes even though the processor only has 6 cores.

_____

(1)

2.3.2 Explain why there are more threads (4781) than processes (306).

(2)

2.3.3 The CPU utilisation is shown as a graph. Give an example of what Ariel could have been doing that caused the sharp spikes in CPU utilisation.

(1)

2.3.4 The specification of the CPU is "up to 4.5 GHz" yet the CPU utilisation shows only 1.31 GHz.

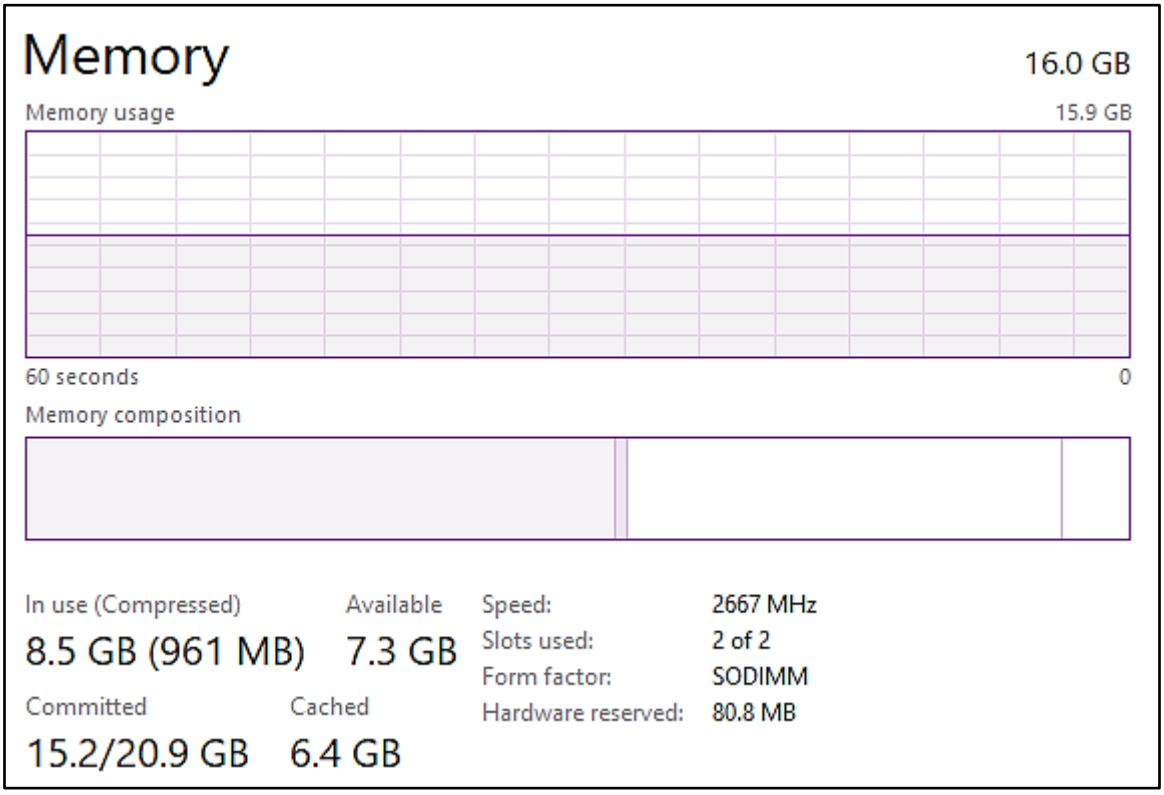
(a) **Name** the hardware technique that allows the processor's speed to be changed.

(1)

(b) Explain why the CPU would be running at 1.31 GHz, using the CPU utilisation graph.

(1)

2.4 Ariel is also looking at the RAM usage for her laptop at the same time as the CPU usage.



2.4.1 The graph shows that 8.5 GB of RAM is in use. Name any TWO system software items that would be loaded in memory.

Item 1: _____

Item 2: _____

(2)

2.4.2 Explain how Ariel's CPU usage is only 10% whereas her RAM usage is more than half (8.5 GB of a total of 16 GB).

_____

_____

_____

_____

_____

(2)

2.5 Ariel's laptop has 4 GB of RAM for the graphics card, yet the details for graphics shown in her Task Manager show 4 GB Dedicated GPU memory and 8 GB Shared GPU memory.

2.5.1 What is the purpose of the graphics card?

(2)

2.5.2 Explain how it is possible to have an extra 8 GB of RAM for her graphics card.

(1)

2.6 Ariel loads an IDE program so that she can code a program in Java. Write down the appropriate term next to the descriptions below:

Description	**Term**
The process that translates the original code to executable form, creating a separate file.	
The original code written in Java.	
A compiled version of the original code that is portable and can be used with different operating systems.	
A programming code that is close to machine code.	

(4)

25 marks

SECTION C NETWORKING

QUESTION 3

When the family is inside or close to their campervan, the family members need to connect to the Internet with their mobile devices. The campervan has a colour laser printer with an Ethernet LAN port, Bluetooth and is Wi-Fi enabled.

3.1 Mr Smith suggests that they create a star topology LAN using UTP cables.

3.1.1 Name TWO disadvantages of copper cables.

Disadvantage 1:

Disadvantage 2:

(2)

3.1.2 What additional device would be needed for a cabled star topology LAN?

(1)

3.2 Ms Smith suggests instead of using UTP cables they connect their devices wirelessly with either Wi-Fi or Bluetooth to create a wireless LAN.

3.2.1 Which method (Wi-Fi or Bluetooth) would you suggest the Smith family use to connect to the printer? Tick the box of the method they should use.

Bluetooth ☐ Wi-Fi ☐

(1)

3.2.2 Give TWO reasons for your choice.

Reason 1:

Reason 2:

(2)

3.2.3 The network would be a peer-to-peer network.

(a) Define a *peer-to-peer network*.

(2)

(b) Explain why the network in this scenario is peer-to-peer.

(1)

3.3 Ariel recently upgraded her cell phone contract and the package included 50 GB of data. She wants to use her cell phone as a hotspot so that all the family members can access the Internet.

Explain how a hotspot differs from a wireless access point.

(2)

3.4 Anastasia says instead of storing data locally, the family can store their data in the cloud.

3.4.1 Do you agree with her answer? YES/NO

YES ☐ NO ☐

(1)

3.4.2 Justify your answer with TWO reasons.

Reason 1:

Reason 2:

(2)

3.5 Ariel wants to voice call her friend from her phone. She chooses to answer using her laptop. To do this they use Google Meet which is a web-based application.

Name THREE protocols that would be used when she communicates with her friend.

Protocol 1:

Protocol 2:

Protocol 3:

(3)

3.6 Anastasia sends a document to the printer from her laptop. The header details of one of the frames sent between the two devices is shown below.

Device	**Label**	**Type of Address**	**Address**
Anastasia's Laptop	A	IP address	192.168.0.4
	B	MAC address	fd01:34d7::520b:b2aa:4f3c
Printer	C	IP address	192.168.0.30
	D	MAC address	ac:d5:64:6d:79:fa

3.6.1 Use the labels A, B, C and D to show the addresses in the frame and packet header. The labels MUST be placed in the correct order.

Frame Header in the correct order

_____

Packet Header in the correct order

_____

(4)

3.6.2 The trailer of the frame contains a Frame Check Sequence (FCS). What is the purpose of the FCS?

_____

_____

_____

(1)

3.7 Ariel decides she wants to download a movie when they arrive at the next town using BitTorrent.

3.7.1 Explain how BitTorrent works.

(2)

3.7.2 Her sister says that BitTorrent is similar to the dark web.

(a) What is the *dark web*?

(2)

(b) Explain why the dark web is not the same as BitTorrent giving TWO reasons.

Reason 1:

Reason 2:

(2)

28 marks

SECTION D SOCIAL IMPLICATIONS

QUESTION 4

Read the following extract adapted from two articles entitled "The "Crypto-" Carbon Crisis: Can CryptoArt and NFTs Be Sustainable?" and "The Climate Controversy Swirling Around NFTs".

Answer the questions that follow.

NFTs (**n**on-**f**ungible **t**okens) are becoming an increasingly popular way to buy and sell digital artworks, though they can also be used for any items such as images, movies, memes, or even music.

An NFT is a unique cryptocurrency token that can take the form of pretty much anything digital — art, a GIF, or even Twitter CEO Jack Dorsey's first tweet. It is a digital asset bought and sold online. They are one of a kind, or very limited, with each NFT having a unique string of code and stored on a **blockchain**. Each NFT has a **digital signature**, serving as proof of ownership.

When an artist wants to create an NFT they must "mint" or mine the artwork for it to become a part of the blockchain. To do this, miners must compete to solve a cryptographic puzzle which uses immeasurable computing power and a lot of energy contributing to greenhouse gas emissions and climate change.

According to researchers, the key reason for this is that most mining takes place in China or the United States, countries that get most of their electricity by burning coal and fossil fuels. They are also the leading countries in **e-waste** worldwide.

[Adapted from: <https://impakter.com/can-cryptoart-and-nfts-be-sustainable/> and <https://www.theverge.com/2021/3/15/22328203/nft-cryptoart-ethereum-blockchain-climate-change? (Accessed 17 January 2022)]

4.1 4.1.1 Define the term *blockchain*.

(2)

4.1.2 Why is the blockchain an ideal way to buy and sell NFTs?

(2)

4.1.3 Give TWO examples of items relating to Ariel's six-month campervan journey that would be ideally suited to sell as an NFT.

Example 1:

Example 2:

(2)

4.2 4.2.1 Define the term *digital signature*.

(2)

4.2.2 How does a digital signature differ from a digital certificate?

(2)

4.3 4.3.1 Give TWO examples of e-waste.

Example 1:

Example 2:

(2)

4.3.2 Name and describe TWO measures the Smith family could use to reduce their e-waste.

Measure 1:

Measure 2:

(2)

14 marks

SECTION E DATA AND INFORMATION MANAGEMENT AND SOLUTION DEVELOPMENT

QUESTION 5

Ariel wants to document the details of their trip. She decides to code a program to store the details of events or locations that the family has participated in. Each family member can upload photos, the date, location, a short entry describing the event and whether the event involved all the members of the family. The photos will be stored in the cloud using a photo sharing app which provides an object called **PhotoObj**. Ariel will use this object as a field in her class to store the photo.

Ariel decides to create a class called **Event**.

Event Class

This class will be used to instantiate **Event** objects, one object for any event that any family member uploads. The class will have the following fields that are not accessible outside the class:

- email : string – identifies the family member who uploaded the event
- eventDate : Date – when the event took place
- location : string – the GPS coordinates of the place where the event took place
- photo : **PhotoObj** – the photo object that is uploaded.
- description : string – a short explanation of the event.
- type : integer – stores a 1 if the event involved an individual or a 2 if the event involved more than one family member.

Ariel decides to add a private counter that will increment each time an **Event** object is created.

- count : integer

Finally, she adds two public constants to indicate the type of event as either individual or family.

- INDIVIDUAL : integer = 1
- FAMILY : integer = 2

5.1 Complete the class diagrams for the **Event** class using the above fields and the following methods.

Methods

- Parameterised constructor method accepting the following parameters: **inE** (string), **inD** (Date), **inL** (string), **inP** (**PhotoObj**), **inDesc** (string), and **inT** (integer);
- Accessor methods for the **photo, location** and **count** fields;
- A **toString()** method that will concatenate the fields of the **Event** object into a string object.

Event
Fields:
Methods:

(10)

5.2 5.2.1 The **Event** class contains a field of the type **PhotoObj**. Is this an example of inheritance or composition? Place a cross next to the correct option.

Inheritance ☐ Composition ☐

(1)

5.2.2 Explain your choice to Question 5.2.1.

(1)

5.3 Explain why the parameterised constructor does not have a parameter for the **count** field.

(2)

5.4 An **eventObj** variable is instantiated using the **Event** class in a frontend application, user interface class. Write Java or Delphi code to:

Display the value of the **count** field.

(3)

5.5 Ariel has created a text file called **event.txt** to store some of the fields for a single **Event** object. The fields **email**, **eventDate**, **description** and **type** are stored in the text file. The fields are separated using commas.

```
email,eventDate,description,type
```

```
mom@smith.co.za,26 June 2022,Kimberley Big Hole,1
```

Change the text file into a JSON file to store the same data as the text file.

(5)
[22]

QUESTION 6

Ariel has too many photos and decides to only allow a photo to be added if it is taken in a new location. The photos are stored in an array of **Event** objects called **eArr** with an integer **size** to record the number of elements in **eArr**.

For simplicity, only the name of the photo and the location, simplified to 3 characters, are shown in the table below.

eArr

0		**1**		**2**		**3**	
location	ABC	**location**	DEF	**location**	XYZ	**location**	MNO
photo	photo9	**photo**	img23	**photo**	pic7	**photo**	pic3

Ariel creates a method called **addPhoto** to add a new **Event** object, called **ev**, to the above array, called **eArr**, if the location of the **Event** object **ev** is unique. The method returns true if the photo was added; otherwise, false.

```
method addPhoto (ev : Event) : boolean
begin
1       for i ← 0 to size – 1 inc by 1
        begin
2               if eArr[i].getLocation() = ev.getLocation()
                begin
3                       return false
                endif
        endfor
4       eArr[size] = ev
5       size++
6       return true
end method
```

The method will be sent the parameter **ev** with the location field set to 'PQR' and the photo set to 'pic5'.

6.1 Complete the trace table in Appendix A on page 22. (8)

6.2 Explain why the for loop in the above code can be considered to execute similarly to a while loop.

(2)
[10]

APPENDIX A

Algorithm	Line No	ev	size	i	i < size-1?	eArr[i]. getLocation() = ev.getLocation()	eArr[0]	eArr[1]	eArr[2]	eArr[3]	eArr[4]	Value returned from method
		location: PQR **photo:** pic5					**location:** ABC **photo:** photo9	**location:** DEF **photo:** img23	**location:** XYZ **photo:** pic7	**location:** MNO **photo:** pic3		
			4									
method addPhoto (ev : Event) : boolean												
begin												
1 for i ← 0 to size – 1 inc by 1												
begin												
2 if eArr[i].getLocation() = ev.getLocation()												
begin												
3 return false												
endif												
endfor												
4 eArr[size] = ev												
5 size++												
6 return true												
end method												

(8)

QUESTION 7

7.1 After a few days, Ariel summarises the uploaded events after the family has visited two locations. The table is shown in Appendix B on page 25.

7.1.1 Give TWO reasons why the table is not normalised to first normal form.

Reason 1:

Reason 2:

(2)

7.1.2 Explain why the combination of **Email** and **Date** fields is not a suitable primary key.

(2)

7.2 The table needs to be normalised to remove data redundancy and anomalies.

7.2.1 Define *data redundancy*.

(2)

7.2.2 Name the THREE types of anomalies that can occur.

Anomaly 1:

Anomaly 2:

Anomaly 3:

(3)

7.3 Normalise the table to third normal form using the **Email** and **Location GPS** fields as a primary key. Write your solution as a set of relations with the primary key underlined.

(10)
[19]

51 marks

APPENDIX B

Email	Name	Date	Location GPS	Location Name	Photo Name	Description	Type
mom@smith.co.za	Mom	26 June 2022	-28° 43' 56.14" S 24° 45' 44.35" E	Kimberley Big Hole	photo1.jpg	Kimberley big hole	FAMILY
dad@smith.co.za	Dad	27 June 2022	-28° 43' 56.14" S 24° 45' 44.35" E	Kimberley Big Hole	DCIM1.png	Big hole	FAMILY
ariel@smith.co.za	Ariel	26 June 2022	-28° 43' 56.14" S 24° 45' 44.35" E	Kimberley Big Hole	Kimberley.jpg	My selfie at Kimberley	INDIVIDUAL
anastasia@smith.co.za	Stassi	28 June 2022	-28° 43' 56.14" S 24° 45' 44.35" E	Kimberley Big Hole	Kimberley.jpg	First day of trip	INDIVIDUAL
dad@smith.co.za	Dad	15 July 2022	-24° 43' 59.99" S 15° 21' 59.99" E	Sossusvlei	DCIM1.png	Sossusvlei	FAMILY
anastasia@smith.co.za	Stassi	16 July 2022	-24° 43' 59.99" S 15° 21' 59.99" E	Sossusvlei	Selfie3.jpg	A big red desert	FAMILY
anastasia@smith.co.za	Stassi	16 July 2022	-24° 43' 59.99" S 15° 21' 59.99" E	Sossusvlei	Sossusvlei.jpg	Sossusvlei Day 2	INDIVIDUAL
ariel@smith.co.za	Ariel	17 July 2022	-24° 43' 59.99" S 15° 21' 59.99" E	Sossusvlei	Sossusvlei.jpg	Interesting sand colour	INDIVIDUAL

SECTION F BOOLEAN LOGIC

QUESTION 8

8.1 In a new programming language a **signed** integer type is allocated 8 bits. A programmer wrote the following code in this language:

```
integer : num;
num = 125;
num = num + 10;
display num;
```

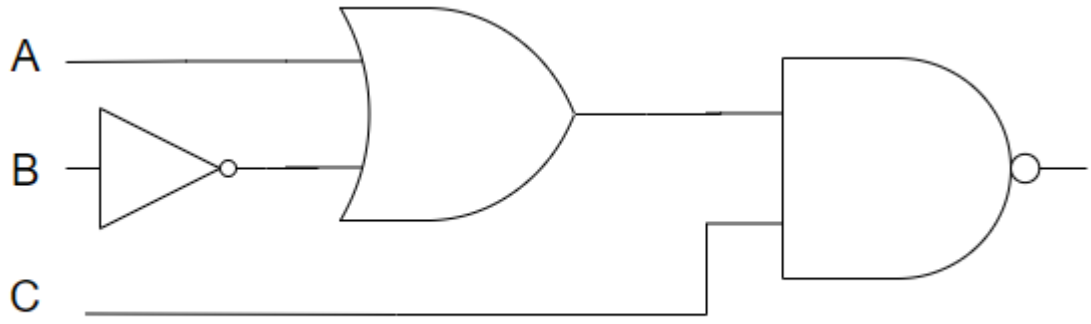
8.1.1 Calculate the largest and smallest number that can be stored in 8 signed bits.

(2)

8.1.2 Explain why a negative number is displayed instead of 135.

(2)

8.2 Write down the Boolean expression for the function F(A,B,C) shown in the circuit diagram below:



F(A,B,C) =

(5)

8.3 Simplify the Boolean expression showing all your workings:

F(A,B,C) = A'B + ABC' + AB

(4)

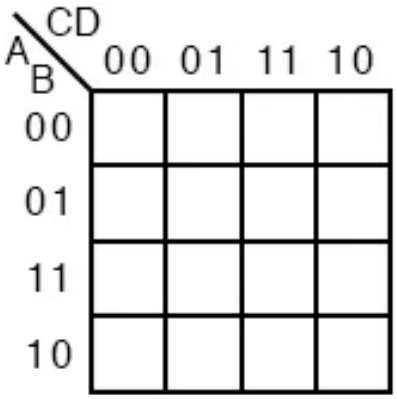
8.4 Using the partially completed truth table below, prove that (A'B + A)B = B.

A	**B**	**(A'B + A)B WORKINGS**	**(A'B + A)B**	**B**
0	0			0
0	1			1
1	0			0
1	1			1

(6)

8.5 Use the Karnaugh map below to simplify the function. Write the simplified function in the block below the Karnaugh map.

F(A,B,C,D) = A'B'C'D' + A'B'C'D + A'B'CD + A'B'CD' + A'BC'D + A'BCD + ABC'D + ABCD + AB'C'D' +AB'C'D + AB'CD + AB'CD'



[<https://www.allaboutcircuits.com/uploads/articles/left-to-right-sequence-across-top-3-variable-map.jpg>]

F(A,B,C,D) =

(6)

25 marks

Total: 150 marks

ADDITIONAL SPACE (ALL questions)

REMEMBER TO CLEARLY INDICATE AT THE QUESTION THAT YOU USED THE ADDITIONAL SPACE TO ENSURE THAT ALL ANSWERS ARE MARKED.

